A Coded Wire Tag Assessment of Salmon River (Langley) Coho Salmon: 1994 Tag Application and 1995-1996 Spawner Enumeration

M. K. Farwell, R. E. Diewert, L. W. Kalnin, J. R. Irvine, R. Semple, and L. C. Walthers

Fisheries and Oceans Canada
Science Branch, Pacific Region
Pacific Biological Station
Nanaimo, British Columbia
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A CODED WIRE TAG ASSESSMENT OF SALMON RIVER (LANGLEY) COHO SALMON: 1994 TAG APPLICATION AND 1995-1996 SPAWNER ENUMERATION

by

M. K. Farwell[1], R. E. Diewert[2], L. W. Kalnin[2], J. R. Irvine, R. Semple[2], and L. C. Walthers[3]

Fisheries and Oceans Canada

Science Branch, Pacific Region

Pacific Biological Station

Nanaimo, British Columbia

V9R 5K6

[1] C.17, Cottonwood Site
Rural Route No. 1
Lone Butte, British Columbia V0K 1X0

[2] Fisheries and Oceans Canada
Stock Assessment Division, Fraser River Interior Office
100 Annacis Parkway
Delta, British Columbia V3M 6A2

[3]StreamLine Research
184 Black Powder Trail
Nanaimo, British Columbia V9S 5G9

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ABSTRACT

Farwell, M. K., R. E. Diewert, L. W. Kalnin, J. R. Irvine, R. Semple, and L. C. Walthers. 2000. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1994 tag application and 1995-1996 spawner enumeration. Can. Manuscr. Rep. Fish. Aquat. Sci. 2524: 38 p.

In the spring of 1994, an estimated 35,256 (corrected for 5.3% long term tag loss) coho smolts were released with coded wire tags at an average size of 90.0 mm and 7.6 g. The adult escapement in fall and winter of 1995-1996 was estimated using the Petersen mark-recapture method. Escapement was estimated at 4,214 coho adults of which 1,248 had coded wire tags and 70 had lost the coded wire tag. Smolt to adult escapement survival averaged 6.6%. Exploitation rate on CWT coho averaged 46.3%.

Escapement progressively declined during 1987-1992, from 11,947 in 1987 to 2,604 in 1992. In 1993, escapement increased to 5,913; however, in 1994 escapement declined to 1,941. The 1995-96 escapement increased to 4,214 adult coho, well below the study period average of 6,156.

RÉSUMÉ

Farwell, M. K., R. E. Diewert, L. W. Kalnin, J. R. Irvine, R. Semple, and L. C. Walthers. 1999. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1994 tag application and 1995-1996 spawner enumeration. Can. Manuscr. Rep. Fish. Aquat. Sci. 2524: 38 p.

Au printemps de 1994, 35 256 smolts de coho (estimation avec correction de 5,3 % pour la perte de marques sur le long terme) marqués avec des micromarques codées ont été libérés à une taille moyenne de 90,0 mm et 7,6 g. On a calculé l'échappée d'adultes à l'automne et l'hiver 1995-1996 par la méthode de marquage-recapture de Petersen. On a estimé l'échappée à 4 214 cohos adultes, dont 1 248 portaient des micromarques codées et 70 avaient perdu leur micromarque. Le taux de survie du smolt à l'adulte était en moyenne de 6,6 %. Le taux d'exploitation par la pêche des cohos portant des micromarques était en moyenne de 46,3 %.

L'échappée a baissé progressivement pendant la période 1987-1992, passant de 11 947 en 1987 à 2 604 en 1992. En 1993, elle a remonté à 5 913; toutefois, l'échappée de 1994 est tombée à 1 941. Pour 1995-1996, l'échappée a remonté à 4 214, ce qui est nettement inférieur à la moyenne de 6 156 de la période d'étude.

INTRODUCTION

In 1986, the Department of Fisheries and Oceans implemented a plan to improve coho salmon (*Oncorhynchus kisutch*) assessment data through the long-term evaluation of indicator stocks. The Salmon River was selected for the evaluation, with known precision, of annual escapement, marine survival, harvest distribution, and exploitation rate. This report documents, for the 1992 brood, the 1994 smolt coded wire tag (CWT) application and the 1995-1996 adult escapement estimation studies. Previous reports documented the evaluation of the 1984-1991 brood years (Schubert and Kalnin 1990; Farwell *et al.* 1991, 1992a, 1992b; Farwell *et al. in press*; Kalnin and Schubert 1991; Schubert *et al.* 1994a, 1994b). This report describes the field methods, analytic techniques and study results, including smolt timing, age and size as well as adult age, length, sex, adipose fin clip (AFC) incidence, escapement estimates and long term CWT loss. The study did not estimate the escapement of precocious males (jacks). The report includes a discussion of data limitations and a synthesis of study results for the 1984-1992 brood years.

STUDY AREA

The Salmon River flows northwest for 33 km, entering the Fraser River west of Fort Langley, B.C. (Fig. 1). Coghlan Creek, the principal tributary, joins the mainstem 14 km upstream from the Fraser River. The system, with an average annual discharge of 1.47 $m^3 * s^{-1}$ (Lynne Campo pers. comm, Environment Canada), drains 85 km^2 of agricultural and residential land. During the Fraser River spring freshet, the Salmon River flows through a pumphouse located at the river mouth. Because no provisions were made for fish passage, up to 31% of the coho smolts are killed as they pass through the pumps (Russell unpublished manuscript, 1981). The study area was divided into ten reaches, five in the Salmon River and five in Coghlan Creek (Fig. 1). Reaches were established to accommodate statistical tests for bias rather than on the basis of homogeneity of physical characteristics. In most study reaches, the river flows across low gradient terrain in a shaded, meandering channel with a gravel substrate. The only exceptions are reaches C5 and S5 where the river is marshy and summer flows are low.

FIELD METHODS

SMOLT CAPTURE

Fence traps similar to those described by Schubert (1982) operated in the Salmon River (30 m above the Coghlan Creek confluence) and in Coghlan Creek (30 m above the Salmon River confluence) from April 20 to May 31, 1994. Captured fish were enumerated at least once daily. Coho smolts were transferred to holding boxes or to the tagging site for tagging and sampling. Coho fry were not enumerated because the 6 mm fence mesh did not fully restrict their passage. The remaining catch was identified to species and released below the fence. Steelhead (*O. mykiss*) and cutthroat (*O. clarki*) trout were recorded as smolt or parr. Trout smolts had a silver coloration and nose-fork (NF) length greater than 110 mm. Parr had distinct lateral parr marks and a length of less than 110 mm.

CODED WIRE TAG APPLICATION (CWT)

The CWT equipment and methods were described by Armstrong and Argue (1977). Coded wire tagging occurred from April 25 to May 31, 1994 at intervals of one to four days. On each day, smolts were sorted by size (NF length greater or less than 100 mm) and separate nose moulds and implant depths were used for each group. Implant depth was checked by bisecting the skull of a tagged smolt along the medial plane. If the CWT was not in the preferred position in the cartilaginous wedge of the skull, the implant depth was adjusted and the procedure repeated until CWT placement was correct. The nose mould was then marked to ensure correct placement following nose mould changes. The smolts were anaesthetized with Tricaine Methane Sulfonate (TMS), marked by adipose fin removal, coded wire tagged and passed through a quality control device to ensure the CWT was present. Any diseased, damaged or undersize (NF length less than 55 mm) smolts were released untagged. A sample of approximately 250 smolts was removed from the recovery bucket and retained for 24 hours to assess AFC quality, delayed mortality and CWT loss. Any smolt without a CWT or with a poor AFC was retagged or reclipped.

SMOLT TRANSPORT

To avoid pump mortality, the coho smolts were transported to and released at the river mouth, either immediately after tagging or in the morning when water temperatures were lower. The smolts were transported in a 180 litre plastic container supplied with air from a 12 volt air pump. Transport required less than 15 minutes.

SMOLT SAMPLING

A total of 50 coho smolts per site were sampled weekly for scales, length and weight. The smolts were anaesthetized with TMS, a scale smear was removed with a scalpel from each side of the fish, NF length was measured to the nearest millimetre, and mean wet weight (±0.1 g) was determined in aggregate using a triple beam balance.

ADULT CAPTURE

Coho adults were captured in reaches S1 to S5 and C1 to C5 (Fig. 1) from November 1 to December 28, 1995. Coho were attracted from logjams and cut banks with a Smith Root Model 12 © 24volt direct current electroshocker. Voltage, amperage, pulse width and frequency were adjusted daily to minimize visible damage (body bruising) while providing sufficient torpor to permit capture. Shocked coho adults (NF length greater than 30 cm) were captured in a dip net, permitted to recover in a 60 litre container of water, marked and released.

Coho adults were marked with Petersen disk tags in a wooden tray (10 cm x 10 cm x 100 cm) constructed with a flexible plastic bottom and a metre stick recessed in one side. The tags consisted of two 22 mm diameter laminated cellulose acetate disks and one 7 mm diameter transparent plastic buffer disk threaded through centrally punched holes onto a 77 mm long nickel pin. The pin was inserted with pliers through the musculature and pterygiophore bones approximately 12 mm below the anterior portion of the dorsal fin insertion.

The disks, arranged with one on each side of the fish and with a buffer disk on the pinhead side, were secured by twisting the pin into a double knot. One disk per pair was numbered with a unique code. Green tags were used to reduce colour contrast, thereby minimizing recovery and predation biases. Each tagged fish received a secondary mark, a 7 mm diameter hole punched through the right operculum using a single hole paper punch, to allow the estimation of tag loss. Males and females received one and two punches, respectively, to permit the estimation of sex identification error. Care was taken to avoid gill tissue damage. Date and location (reach) of capture, disk tag number, NF length (±0.5 cm), sex and adipose fin status were recorded for each fish released with a disk tag. Activity at release was recorded as 1 (swam away vigorously), 2 (swam away sluggishly) or 3 (required ventilation). Electroshocker bruising to the body was recorded as 0 (none), 1 (faint bruise), 2 (bruise up to 25 mm in diameter), 3 (bruise over 25 mm in diameter). Recovered disk tagged carcasses were enumerated and sampled (described below) to assess handling mortality.

SPAWNING GROUND SURVEYS

The spawning grounds were surveyed weekly from November 17, 1995 to January 26, 1996. Complete surveys, conducted by a two to four person crew walking upstream, required up to two days. Live adults were counted and carcasses were recorded by date, reach, sex (confirmed by abdominal incision) and mark type (disk tag, secondary mark or AFC). Each marked carcass and every tenth unmarked carcass was sampled. All carcasses were then cut in two with a machete and returned to the river. Sample data, recorded by date and reach, included postorbitalhypural plate (POH) length (to the nearest 0.1 cm), sex, female spawning success (0%, 50% or 100% spawned), adipose fin and carcass condition, and scale samples. For AFC coho, the head was removed posterior to the eye orbit for later CWT identification. Adipose fin condition was recorded as unclipped, complete (flush with dorsal surface), partial (nub present) or questionable (appeared clipped but fungus or decomposition obscured the area). The condition of AFC carcasses was recorded as fresh (gills red or mottled), moderately fresh (gills white, body firm), moderately rotten (body intact, flesh soft) or rotten (skin and bones), and the absence of one or both eyes was noted.

ANALYTIC PROCEDURES

TESTS FOR SAMPLING SELECTIVITY

Period

Temporal bias was assessed using a chi-square test (Sokal and Rohlf 1981). Application bias was examined by comparing between periods the mark incidence in the recovery sample, where mark incidence was the proportion of the coho adults marked with either a disk tag or a secondary mark. Recovery bias was examined by stratifying the application sample by period and comparing proportions recovered.

Location

Spatial bias was similarly assessed in the application sample by comparing between sections the mark incidence in the recovery sample. Recovery bias was examined by stratifying the application sample by section and comparing the proportions recovered.

Fish Size

Size related bias was assessed using the Kolmogorov-Smirnov two sample test (Sokal and Rohlf 1981). Application bias was examined by comparing the POH length-frequency distributions of marked and unmarked spawning ground recoveries. Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing the NF length-frequency distributions of each.

Fish Sex

Sex related bias was assessed using chi-square tests. Application bias was examined by comparing the sex ratio of the marked and unmarked spawning ground recoveries. Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing the sex composition in each.

Other Tests

Bias resulting from tagging stress was also assessed using chi-square tests as above. The application sample was partitioned into those fish that required ventilation at release and those which did not, and those with electroshocker bruising at release and those with none. Recovery rates were compared in each group. As well, spawning success was compared in marked and unmarked spawning ground recoveries.

ESTIMATION OF SPAWNER POPULATION

Total Escapement

The escapement of Salmon River coho adults was calculated from the mark-recapture data using the Petersen formula (Chapman modification) (Ricker 1975). Total escapement was the sum of escapement by sex:

1) Estimated coho escapement for each system (N_t):

$$N_t = N_m + N_f$$

where:

N_m = estimated escapement of adult males;

$$= \frac{(M_m + 1)(C_m + 1)}{(R_m + 1)}$$

N_f = estimated escapement of females, analogous to above.

2) Estimated 95% confidence limits of N_t:

$$N_t \pm 1.96\sqrt{v_t}$$

where:

v_t = variance of the escapement estimate;

= $v_m + v_f$

v_m = variance of the adult male escapement estimate;

$$= \frac{\left(N_m^2\right)\left(C_m - R_m\right)}{\left(C_m + 1\right)\left(R_m + 2\right)}$$

C_m = number of adult male carcasses examined for disk tags;

R_m = number of disk tagged/secondary marked adult males recovered; and

v_f = variance of female escapement estimate, analogous to above.

Sex Identification Correction

The tag application data were corrected for sex identification error. Error occurred because the development of sexually dimorphic traits was often not advanced and internal examinations could not be made. The correction of the recovery data was unnecessary because all carcasses were incised and examined internally. Sex identification error was corrected as described by Staley (1990):

3) Estimated true number of males released with disk tags and secondary marks (M_m):

$$M_m = \frac{M_m^* - \left(M_t R_{m.f}\right) / R_f}{1 - \left(R_{m.f} / R_f\right) - \left(R_{f.m} / R_m\right)}$$

where:

M_m^* = field estimate of number of males released with disk tags and secondary marks;

M_t = total number of coho adults released with disk tags and secondary marks;

$R_{m.f}$ = number of females recovered with disk tags which were released as males;

R_f = number of females recovered with disk tags;

R_m = number of males recovered with disk tags.

4) Estimated true number of females released with disk tags and secondary marks (M_f):

$$M_f = M_t - M_m$$

Adipose Fin Clipped Escapement

We estimated the AFC escapement from the AFC incidence in the carcass recovery sample, the largest of the two available samples. The AFC incidences in the Salmon River and Coghlan Creek were first tested for significant differences using a chi-square test. If no difference was noted, the AFC escapement was the product of the pooled AFC incidence and the mark-recapture escapement estimate. The 95% confidence limits were calculated from the respective upper and lower confidence limits of the AFC incidence and the escapement estimate. For example, the upper 95% confidence limit of the AFC escapement estimate was the product of the upper limit of the AFC incidence and the upper limit of the total mark-recapture estimate. The mathematical relationships are reported below (Cochran 1977):

5) Estimated AFC escapement (N_a):

$$N_a = p(N_t)$$

6) Ninety-five percent confidence limits for p:

$$p \pm (1.96se + fpc)$$

where:

p = sample proportion with an AFC;

se = standard error;

$$= \sqrt{(1-f)pq/(n-1)}$$

fpc = finite population correction;

$$= \frac{1}{2n}$$

n = sample size;

$$q = 1 - p$$

$$f = \frac{n}{N_t}$$

If the Salmon River and Coghlan Creek AFC incidences differed, then the AFC escapement

estimate was the product of the stream-specific total escapement, the stream-specific AFC incidence, and the pooled CWT retention level. Total escapement by stream was calculated by applying the ratio of the stream-specific Schaefer estimates (Ricker 1975) to the Petersen estimate. Confidence limits are not reported for the AFC escapement using this method.

Coded Wire Tagged Escapement

Escapement by CWT code and long term CWT loss were calculated by applying the CWT composition in the carcass recovery sample to the estimated escapement of AFC adults. Apparent CWT loss was adjusted for post-mortality loss resulting from carcass decomposition and predator activity, where appropriate.

HARVEST SAMPLING

Harvest data were obtained from the regional CWT mark recovery database (Kuhn *et al.* 1988) and were treated for sampling problems as described by Schubert *et al.* (1994a).

RESULTS

SMOLT CAPTURE

Catch of coho smolts totalled 41,838 in 1994, 27,249 in Salmon River and 14,589 in Coghlan Creek (Appendix 1). The 50% migration and the peak daily catch occurred on May 7 and May 6, respectively, in the Salmon River and on May 6 and May 8, in Coghlan Creek. Catches were not seriously disrupted by changing water levels; however, notable catches were made at both sites on the first day of trap operation. Therefore, the observed timing of the 1994 smolt migration may be somewhat biased.

CODED WIRE TAG APPLICATION

AFC and CWT releases totalled 37,799 coho smolts in 1994 (Appendix 2). When adjusted for long term CWT loss (5.3%) (Appendix 9) and short-term (24-hour) post tagging mortality (Appendix 2), the number released with CWTs and identifiable AFCs was 35,256. Short-term CWT loss averaged 1.4% (range 0.0% to 12.5%) (Appendix 2). The incidence of disease, damage, or structural anomalies averaged 7.1% (Appendix 3). The most prevalent condition was fog eye (3.1%), a reversible condition associated with capture stress. Naturally missing adipose fins (0.06%) were observed in 23 fish. Careful observation of these missing fins did not reveal evidence of fin clipping.

COHO SMOLT AGE AND SIZE

Of the smolts sampled emigrating from the Salmon River system, 98.9% were age 1+ and 1.1% were age 2+. Smolt size averaged 89.2 mm and 7.5 g in the Salmon River and 91.6 mm and 7.9 g in Coghlan Creek (Appendix 4). Weighted mean smolt size was 90.0 mm and 7.6 g. Smolt size peaked in the early portion of the migration period.

DISK TAG APPLICATION

Disk tags and secondary marks were applied to 250 coho adults in the Salmon River system from November 1 to December 28, 1995 (Appendix 5); 78 (31.2%) had an AFC. In the Salmon River 144 tags (57.6%) were applied and in Coghlan Creek 79 (31.6%) tags were applied; most were released in reaches S1 (28.8%), C1 (26.0%) and S3 (14.0%).

There were 13 fish which (5.2%) required ventilation at release. The proportion of this group recovered (15.4%) was not significantly different ($p > 0.05$; chi-square) from the remaining fish (12.7%) (Table 2). Electroshocker bruising was noted in 69 fish (27.6%) (Table 2). The proportion of this group recovered (7.2%) was not significantly lower ($p > 0.05$; chi-square) than the unbruised group (14.9%) (Table 2). Consequently, neither the bruised nor the ventilated group of fish was removed from the application sample.

None of the females and males were misidentified at the time of tagging (Appendix 6). Therefore, no adjustment was required for sex identification errors. There were 146 (58.4%) males and 104 (41.6%) females released with disk tags and secondary marks (Table 1).

The mean NF length of females (54.4 cm) was significantly different ($p < 0.05$; ANOVA) from that of males (52.1 cm). In females, fish with AFCs (54.5 cm) were larger than unmarked fish (54.3 cm), while in males, unmarked fish (52.4 cm) were larger than those with and AFC (51.4 cm); however, these differences were not significant ($p > 0.05$; ANOVA).

In 1995-1996, no previously tagged fish were recaptured in later capture periods.

SPAWNING GROUND RECOVERY

A total of 502 adults and 31 jacks were recovered on the spawning grounds from November 17, 1995 to January 26, 1996 (Table 1; Appendix 7). Of the adults, 244 (48.6%) were male, 219 (43.6%) were female, and 39 (7.8%) were not identified by sex; 157 (31.3%) of the adults had an AFC, 23 (4.6%) had a disk tag and secondary mark, 9 (1.8%) had no secondary mark and none had lost a disk tag. The proportion of disk tags recovered in females (14.4%) and males (8.2%) was not significantly different ($p > 0.05$; chi-square). The proportion of disk tagged fish which was recovered was not significantly different ($p > 0.05$; chi-square) in those with AFCs (16.7%) from those without an AFC (11.0%).

The distribution of carcass recoveries was 228 adults (45.4%) in the Salmon River and 274 (54.6%) in Coghlan Creek (Table 5). Most were recovered in reaches C1 (19.5%), C2 (17.3%) and S1 (16.7%).

Age, Length and Sex

The age and length of the 1995-1996 spawning ground recoveries are reported in Appendix 8. Age 3_2 fish comprised 100% of the adult females and 95.7% of the males. No difference in age composition was noted between streams or by AFC status ($p > 0.05$; chi-square). The mean POH length of males (42.4 cm) was significantly smaller ($p < 0.05$; ANOVA) than that of females (44.3 cm). In both sexes, fish with AFCs (males 42.0 cm, females 44.0 cm) were smaller than unmarked fish (males 43.0 cm, females 44.7 cm); however, the differences were not significant ($p > 0.05$; ANOVA).

Coded Wire Tag Recoveries

There were 77 of the 244 male and 75 of the 219 female carcasses recovered with an AFC, an incidence of 31.6% and 34.2%, respectively. The AFC incidence was not significantly different ($p > 0.05$; chi-square) between streams or sexes (Appendix 9). CWTs were recovered from 62 adult males and 52 adult females; all were 1992 brood Salmon River system coho. CWTs were recovered from 4 jack coho (Appendix 9). CWTs recovered in the Salmon River were largely (71%) of Salmon River origin, while those in Coghlan Creek were largely (90%) of Coghlan Creek origin (Appendix9). The fidelity of Salmon River origin CWT code 18 06 63 was significantly lower (60.7%) than that of the other CWT codes (85.9%) ($p < 0.05$; chi-square).
CWT loss was not significantly different in carcasses with both eyes (22.7%) versus those missing one or both eyes (21.2%) ($p > 0.05$; chi-square) (Appendix 10). A significant difference ($p < 0.05$) was noted between fresh and moderately rotten carcasses (8.2%) and fully rotten (33.8%) carcasses. CWT loss in carcasses with complete AFCs (7.4%) was significantly lower ($p < 0.05$) than the loss in carcasses with partial or questionable (39.0%) AFCs (Appendix 10). When rotten carcasses and those with partial or questionable clips were removed from the sample, the adjusted long-term CWT loss was 5.3%. No difference ($p > 0.05$; chi-square) in CWT loss was noted between the study streams or between sexes (Appendix 9).

SAMPLING SELECTIVITY

Period

Temporal bias in the application sample was examined by comparing mark incidences in three recovery periods (Table 3). Mark incidences ranged from 0.0% to 9.3%. The difference was significant ($p < 0.05$; chi-square) only in females. The highest mark incidences occurred in the early recovery period.

Recovery bias was examined by comparing the proportions recovered from three application periods (Table 4). The proportions ranged from 7.1% to 26.7%, with the difference being significant ($p < 0.05$) only in females. The highest recovery rate was from the middle tag application period.

Location

Spatial bias in the application sample was examined by comparing the mark incidences in 5 recovery sections (Table 5). Mark incidence ranged from 0.0% to 15.4%; the difference

was significant ($p < 0.05$; chi-square) only in females. Mark incidence was highest in the lower section of Coghlan Creek.

Recovery bias was examined by stratifying the application sample into five sections and comparing the proportions recovered (Table 6). The percentages ranged from 0.0% to 29.2%. The difference was significant ($p < 0.05$) only in females. Recovery rate was highest in upper Coghlan Creek.

Fish Size

Size related bias in the application sample was examined by comparing POH length-frequency distributions of marked and unmarked spawning ground recoveries. No significant difference ($p > 0.05$; Kolmogorov-Smirnov two sample test) was noted in males or females.

Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing NF length-frequency distributions of each. No significant difference ($p > 0.05$) was noted; however, when the data were stratified by 10 cm increments of nose-fork length, a trend to larger fish being recovered at a higher rate was observed (Table 7).

Fish Sex

Application bias was assessed by comparing sex ratios of marked and unmarked spawning ground recoveries. A significant difference ($p > 0.05$; chi-square) was noted with more marked females than expected (Table 8).

Recovery bias was assessed by comparing sex ratios of recovered and not recovered disk tagged fish. A significant difference ($p > 0.05$) was noted with more marked females recovered than expected.

Spawning Success

Spawning success, estimated from the internal examination of female spawning ground recoveries, was estimated at 98.7% (Appendix 11). Spawning success of marked (93.3%) and unmarked (99.3%) females was not significantly different ($p < 0.05$; chi-square).

ESTIMATION OF SPAWNER POPULATION

Total Escapement

The 1995-1996 escapement of Salmon River coho adults calculated by the Petersen estimator was 4,214, with lower and upper 95% confidence limits of 2,655 and 5,773, respectively (Table 10). The escapement was the total of 2,770 adult male and 1,444 adult female coho. Significant spatial and temporal biases were identified in this study (Table 9; see Discussion), therefore, the escapement estimate calculated using the Petersen estimator could be biased. The estimated escapement calculated using the Schaefer method was 4,919 when the data were spatially stratified and was 4,419 when the data were temporally stratified.

The total escapement was allocated between the Salmon River and Coghlan Creek by applying proportions calculated from the Schaefer spatially stratified estimate. The Salmon River accounted for 58.8% (2,478) of the total escapement, 40.9% (1,132) of the adult male escapement and 71.2% (1,027) of the female escapement. Age 3_2 fish dominated the adult escapement (99.3%); only 0.7% were age 4_3 (Appendix 8).

Adipose Fin Clips and Coded Wire Tags

The AFC incidences in the Salmon River (31.1%) and Coghlan Creek (31.4%) were not significantly different ($p > 0.05$; chi-square). The AFC escapement, therefore, was derived from the pooled AFC incidence of 31.3%. The AFC escapement was 1,318 adults, with lower and upper 95% confidence limits of 823 and 1,821, respectively (Table 10). The AFC escapement by stream was the product of the Petersen estimate for the entire system and the ratio of the stream specific Schaefer estimates. Of the estimated 1,318 coho adult AFC escapement, 775 returned to the Salmon River and 543 to Coghlan Creek (Table 11). Of the total, 83 returned with code 18 06 52, 445 with code 18 06 61, 377 with code 18 06 62, 343 with code 18 06 63, and 70 (5.3%) had lost the CWT. Survival from smolt release to adult escapement averaged 3.7%. There was a significant difference ($p < 0.05$; chi-square) in survival between the releases in Salmon River (4.4%) and Coghlan Creek (3.2%). Within Coghlan Creek, survival of code 18 06 52 (1.6%), released in the latter part of May, was significantly lower ($p < 0.05$) than that of the other two earlier releases (3.6%).

DISCUSSION

PROGRAM EFFECTIVENESS

The effectiveness of the 1992 brood juvenile program was evaluated by examining the number of smolts trapped and the AFC incidence in the subsequent adult escapement. The 1992 brood release of CWT coho smolts (35,256) was higher than the previous eight year average of 21,629 (Table 12) while the AFC incidence in the subsequent escapement (30.3%) was the highest observed over the previous eight years and well above the average of 16.8% (Table 13). These data suggest that the efficiency of the 1994 trapping program was high and that smolt production was near average. The conclusion about high efficiency is consistent with the observation that the traps were fully operative for the duration of the capture period. Emigration prior to the capture period was probable; however, the data suggest that the number of early migrants was not large. The conclusion about smolt production was supported by the index of smolt abundance (Table 12). The index, a Petersen estimate indicative of gross changes in annual smolt production (Schubert *et al.* 1994b), for the 1992 brood smolt production was 1.22, below the 1984-1991 brood average of 1.75.

The effectiveness of the 1992 brood adult program was evaluated by observing trends in the proportions of the population, which were handled during tag application and carcass recovery. In 1995-1996, tags were applied to 5.9% of the population, well below the study period average of 8.3% (Table 13). The proportion of the escapement censused (11.9%) and of the marks recovered (12.8%) were well below the study period averages of 19.4% and 19.8%, respectively. These results indicate that the 1995-1996 marking and recovery program performance was below average. High water discharges, as a result of prolonged periods of

heavy rain, was felt to be the main contributor to the low effectiveness of the 1995-1996 adult program.

MARK-RECAPTURE STUDY

Population estimates derived from mark-recapture studies are susceptible to bias from a number of sources, including: tag loss; physiological stress which can induce the emigration of tagged fish from the population or alter recapture vulnerability; and non-representative tag application or recovery resulting from samples which are selective by fish size, sex or spatial and temporal component.

To compensate for anticipated tag loss we provided a secondary mark on all released fish. Although no carcasses with only a secondary mark were recovered, there were 9 carcasses without a secondary mark. These carcasses were all missing heads or opercula when recovered. We concluded that tag loss was not a significant source of bias in 1995-1996.

Schubert *et al.* (1994b) reported that the use of electroshockers to capture adult coho does not influence subsequent catchability or survival. However, Farwell *et al.* (*in press*) reported that apparently appropriate current settings on a poorly maintained electroshocker can influence subsequent catchability or survival of fish. In 1995-1996, the electroshocker was well maintained and the current settings were similar to those used in past studies. Consistent with the majority of those studies, the current year's observations showed no significant influence on subsequent catchability. We concluded that bias resulting from the stress of capture and tagging was not serious in 1995-1996.

It was not possible to definitively test the representativeness of the application and recovery samples because the true population parameters were not known. Instead, we examined the samples for four biases, temporal, spatial, fish size and fish sex, as indicators of weakness in the study design. A bias towards females was present in both samples (Table 9). To minimize this bias the Petersen estimate was calculated by sex. Spatial and temporal biases were identified in both samples (Table 9). Ricker (1975) noted that, when non-representative sampling occurs in both samples, the Petersen estimate may be biased. To determine the seriousness of the spatial bias, we stratified the data by stream section and estimated the escapement using Schaefer's modification of the Petersen method (Ricker 1975). This estimate (4,919) was 17% higher than the Petersen estimate but well below its upper 95% confidence limit. The importance of the temporal bias was assessed by stratification of the data by time period and calculation of a Schaefer estimate. This estimate (4,419) was 5% higher than the Petersen estimate and well below its 95% upper confidence limit. Based on these small differences, we concluded that the Petersen estimate was not significantly biased by these non-representative samples.

STOCK STATUS

The status of the Salmon River system coho stock was inferred from trends in adult escapement, smolt production, exploitation rate and smolt to adult survival (Fig. 2). In an evaluation of stock status through the 1991 brood year, Farwell *et al.* (*in press*) noted a

declining trend for the 1987-1988 through 1994-1995 escapement years. The present study indicates an increase in the escapement; however, the overall trend was still downward (Fig. 2). Similarly, smolt production and smolt to adult survival continue to show significant downward trends (Fig. 2).

SUMMARY

1) The Salmon River (Langley) supports one of a group of B.C. coho stocks being monitored for responses to management actions by measuring annual escapement, marine survival, harvest distribution and exploitation rate. This report documents the 1992 brood year results.

2) Coded wire tags (CWTs) and adipose fin clips (AFCs) were applied to emigrant smolts at fence traps in Salmon River and Coghlan Creek, the principal tributary, from April 25 to May 31, 1994. Tagged smolts were transported and released below a pumphouse at the river mouth.

3) A total of 35,256 coho smolts were released with CWTs and AFCs. Size averaged 90.0 mm nose-fork length and 7.6 g wet weight.

4) Adult spawners were enumerated by a mark-recapture study from November 1, 1995 to January 26, 1996. Coho adults were captured using an electroshocker and marked with disk tags and opercular punches. Escapement was censused by the recovery of carcasses following spawning.

5) The 1995-1996 coho adult escapement was estimated from a tag application sample of 250, a recovery sample of 502, and a recovery of 32 tags or secondary marks. The escapement was estimated at 4,214 adults, of which 2,770 were male, 1,444 were female and 1,318 had AFCs. Long term CWT loss was 5.3%.

6) The proportion of the smolt release which returned to the spawning grounds was 3.7%. The proportion was higher in Salmon River (4.4%) than in Coghlan Creek (3.2%).

7) Most (99.3%) of the adult escapement was age 3_2. Adult POH length averaged 44.3 cm for females and 42.4 cm for males.

8) Sexual, spatial, and temporal biases in the application and recovery samples were identified during this study. The sex bias was minimized by calculating escapement estimates by sex. The spatial and temporal biases were assessed by stratifying the data. The resulting estimates were well within the confidence limits of the Petersen estimate. The biases were considered to have an insignificant impact on the Petersen estimate.

9) The increased escapement observed in 1995-1996 was apparently the result of a decreased exploitations.

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Table 1. Disk tag application, carcass examination and mark recovery, by sex, of Salmon River system coho adults, 1995-1996.

Sex	Disk tags applied	Carcasses examined	Marks recovered: Disk tag and secondary mark	Marks recovered: Secondary mark only	Marks recovered: Disk tag only	Marks recovered: Total	Percent recovered
Male	146	244	10	0	2	12	8.2%
Female	104	219	13	0	2	15	14.4%
Total	250	502 a	23	0	9 b	32	12.8%

a. Includes 39 coho of unknown sex.
b. Includes 5 coho of unknown sex.

Table 2. Disk tag application and recovery of Salmon River system coho adults, by release condition, 1995-1996.

Category	Release condition	Disk tags applied	Disk tags recovered	Percent recovered
Swimming performance	Normal	237	30	12.7%
	Required ventilation	13	2	15.4%
Body bruising	None visible	181	27	14.9%
	Present	69	5	7.2%

Table 3. Incidence of disk tags or secondary marks in coho adults recovered on the Salmon River system spawning grounds, by recovery period and sex, 1995-1996.

Recovery period	Recovered with disk tag or secondary mark: Male	Female	Total	Total recovery: Male	Female	Total	Mark incidence: Male	Female	Total
15-Nov to 14-Dec	7	10	17	117	107	234 c	6.0%	9.3%	7.3%
15-Dec to 01-Jan	3	5	11 b	94	73	182 d	3.2%	6.8%	6.0%
02-Jan to 26-Jan	2	0	4 a	33	39	86 e	6.1%	0.0%	4.7%

a. Includes 2 coho of unknown sex.
b. Includes 3 coho of unknown sex.
c. Includes 10 coho of unknown sex.
d. Includes 15 coho of unknown sex.
e. Includes 14 coho of unknown sex.

Table 4. Proportion of the disk tag application sample recovered on the Salmon River system spawning grounds, by application period and sex, 1995-1996.

Application period	Disk tags and secondary mark applied			Carcasses recovered with disk tags			Percent recovered		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
01-Nov to 15-Nov	84	53	137	6	5	14 a	7.1%	9.4%	10.2%
16-Nov to 30-Nov	39	30	69	4	8	14 b	10.3%	26.7%	20.3%
01-Dec to 28-Dec	23	21	44	2	2	4	8.7%	9.5%	9.1%

a. Includes 3 coho of unknown sex at recovery.
b. Includes 2 coho of unknown sex at recovery.

Table 5. Proportion of the Salmon River system coho adult spawning ground recovery sample marked with disk tags or secondary marks, by recovery section and sex, 1995-1996.

Location	Recovery section a	Carcasses recovered with disk tags or secondary marks			Coho adult carcasses examined			Mark incidence		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Salmon River	Lower	3	3	7 b	46	38	89 d	6.5%	7.9%	7.9%
	Middle	2	1	3	30	29	66 f	6.7%	3.4%	4.5%
	Upper	2	0	2	39	29	73 d	5.1%	0.0%	2.7%
Coghlan Creek	Lower	2	4	8 c	22	26	53 d	9.1%	15.4%	15.1%
	Upper	3	7	12 c	107	97	221 e	2.8%	7.2%	5.4%

a. Salmon River: lower - S1, S2; middle - S3; upper - S4, S5.
Coghlan Creek: lower - C1; upper - C2, C3, C4, C5.
b. Includes 1 coho of unknown sex.
c. Includes 2 coho of unknown sex.
d. Includes 5 coho of unknown sex.
e. Includes 17 coho of unknown sex.
f. Includes 7 coho of unknown sex.

Table 6. Proportion of the disk tag application sample recovered on the Salmon River system spawning grounds, by application section and sex, 1995-1996.

Location	Recovery section a	Carcasses recovered with disk tags or secondary marks			Coho adult carcasses examined			Mark incidence		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Salmon River	Lower	44	22	66	4	2	8 b	9.1%	9.1%	12.1%
	Middle	23	17	40	3	1	4	13.0%	5.9%	10.0%
	Upper	19	19	38	0	0	0	0.0%	0.0%	0.0%
Coghlan Creek	Lower	32	22	54	3	5	10 b	9.4%	22.7%	18.5%
	Upper	28	24	52	2	7	10 c	7.1%	29.2%	19.2%

a. Salmon River: lower - S1, S2; middle - S3; upper - S4, S5.
Coghlan Creek: lower - C1; upper - C2, C3, C4, C5.
b. Includes two coho of unknown sex at recovery.
c. Includes one coho of unknown sex at recovery.

Table 7. Proportion of the Salmon River system coho adult disk tag application sample recovered on the spawning grounds, by 10 cm increments of nose-fork length and sex, 1995-1996.

Nose-fork length (cm)	Disk tags applied			Carcasses recovered with disk tags			Percent recovered		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
30-39.9	6	1	7	0	0	0	0.0%	-	0.0%
40-49.9	42	12	54	1	0	1	2.4%	0.0%	1.9%
50-59.9	82	79	161	9	13	27 a	11.0%	16.5%	16.8%
60-69.9	13	11	24	2	2	4	15.4%	18.2%	16.7%
70-79.9	3	1	4	0	0	0	0.0%	0.0%	0.0%

a. Includes 5 coho of unknown sex at recovery.

Table 8. Sex composition of Salmon River system coho adults in the disk tag application and spawning ground recovery samples, 1995-1996.

	Application sample sex ratio by recovery status				Recovery sample sex ratio by mark status			
Sex	Sample size a	Recovered	Not recovered	Total	Sample size b	Marked	Unmarked	Total
Male	146	44.4%	60.6%	58.4%	244	44.4%	53.2%	52.7%
Female	104	55.6%	39.4%	41.6%	219	55.6%	46.8%	47.3%

a. Includes 5 of unknown sex at recovery b. Excludes 39 coho of unknown sex.

Table 9. Results of the statistical tests for bias in the 1995-1996 Salmon River system coho adult escapement estimation study. a

Bias type	Application sample	Recovery sample
Statistical	-	No bias
Period	Females biased to early period	Females biased to middle period
Location	Females biased to lower Coghlan	Females biased to Upper Coghlan
Fish size	No bias	No bias
Fish sex	Bias to females	Bias to females

a. A "no bias" test result indicates that bias was not detected; undetected biases may be present.

Table 10. Escapement estimates and 95% confidence limits, by sex and age, for Salmon River system coho adults, 1995-1996.

Group	Escapement by age			95% confidence limits on escapement estimate	
	3/2	4/3	Total	Lower	Upper
Male	2,690	80	2,770	1,358	4,183
Female	1,444	0	1,444	783	2,105
Total	4,134	80	4,214	2,655	5,773
AFC	-	-	1,318	823	1,821

Table 11. Smolt releases, adult escapement and survival to adult escapement, by location and CWT code, of 1992 brood Salmon River system coho salmon.

Location		CWT code				Adult escapement with an AFC but without a CWT
		18 06 52	18 06 61	18 06 62	18 06 63	
Salmon River	Number of smolts released a	5,061	-	9,973	10,084	-
	Spawning ground recoveries					
	Number	5	5	22	17	-
	Percent by code	10.2%	10.2%	44.9%	34.7%	-
	Escapement b	75	75	329	255	41
Coghlan Creek	Number of smolts released a	-	10,138	-	-	-
	Spawning ground recoveries					
	Number	1	46	6	11	-
	Percent by code	1.6%	71.9%	9.4%	17.2%	-
	Escapement b	8	370	48	88	29
Total	Escapement	83	445	377	343	70
	Survival to escapement	1.6%	4.4%	3.8%	3.4%	-

a. Adjusted for long term CWT loss.

b. Product of the stream-specific escapement, pooled AFC incidence, pooled CWT retention, and proportion by code.

Table 12. Trends in smolt production, smolt-to-adult survival, exploitation rate and escapement of coded wire tagged 1984-1992 brood Salmon River system coho salmon.

Dominant brood year	Smolts released with CWT's [a]	Smolt production index	Fishery CWT harvest [b]	Adult CWT escapement [c]	Total survival	Exploitation rate [e]	Adult escapement in brood year + 3
1984	7,891	2.94	852	373	15.5	69.6	11,947
1985	20,022	1.60	3,292	1,102	21.9	74.9	9,152
1986	24,634	2.39	2,419	903	13.5	72.8	8,427
1987	26,911	1.69	2,676	801	12.9	77.0	4,942 [d]
1988	20,390	2.13	1,202	371	7.7	76.4	4,321
1989	29,435	1.15	2,105	730	9.6	74.3	2,604
1990	28,141	1.52	1,290	1,079	8.4	54.5	5,913
1991	15,611	0.58	999	523	9.7	65.6	1,941
1992	35,256	1.20	1,335	1,248	7.3	51.7	4,214

[a] Corrected for long term CWT loss.

[b] Harvest in brood year + 3 only. In some cases the CWT harvest may be a little higher than earlier estimates as PMFC (Pacific Marine Fisheries Commission) numbers were not available in some years, but have been added here. The influence is in all cases very small.

[c] Data for brood year 1984-1988,inclusive recalculated from Farwell et al.(1992) using AFC

incidence stratified by stream;1989-1992 data follow same procedure.

[d] Recalculated from Farwell et al. (1991) to correct an error in the mark -recapture data.

[e] Catch / catch and escapement

Table 13. Program effectiveness as indicated by the capture, marking, and recapture of adult coho in the Salmon River system, 1987-1988 through 1995-1996.

Year	Adult escapement	Application sample		Recovery sample			Disk tags or secondary marks recovered	
		Number	Percent of escapement	Number	Percent escapement	AFC incidence	Number	Percent recovered
1987-1988	11,947	1,322	11.1%	3,302	27.6%	3.4%	352	26.6%
1988-1989	9,152	717	7.8%	1,377	15.0%	14.4%	107	14.9%
1989-1990	8,427	495	5.9%	1,327	15.7%	10.9%	80	16.2%
1990-1991	4,942 a	430	8.7%	864	17.5%	19.4%	75	17.4%
1991-1992	4,321	405	9.4%	696	16.1%	10.3%	66	16.3%
1992-1993	2,604	152	5.8%	460	17.7%	26.8%	25	16.4%
1993-1994	5,913	490	8.3%	1,045	17.7%	20.0%	84	17.1%
1994-1995	1,941	91	4.7%	480	24.7%	29.0%	22	24.2%
1995-1996	4,214	250	5.9%	502	11.9%	30.3%	32	12.8%

a. Recalculated from Farwell et al. (1991) to correct an error in the mark-recapture data.

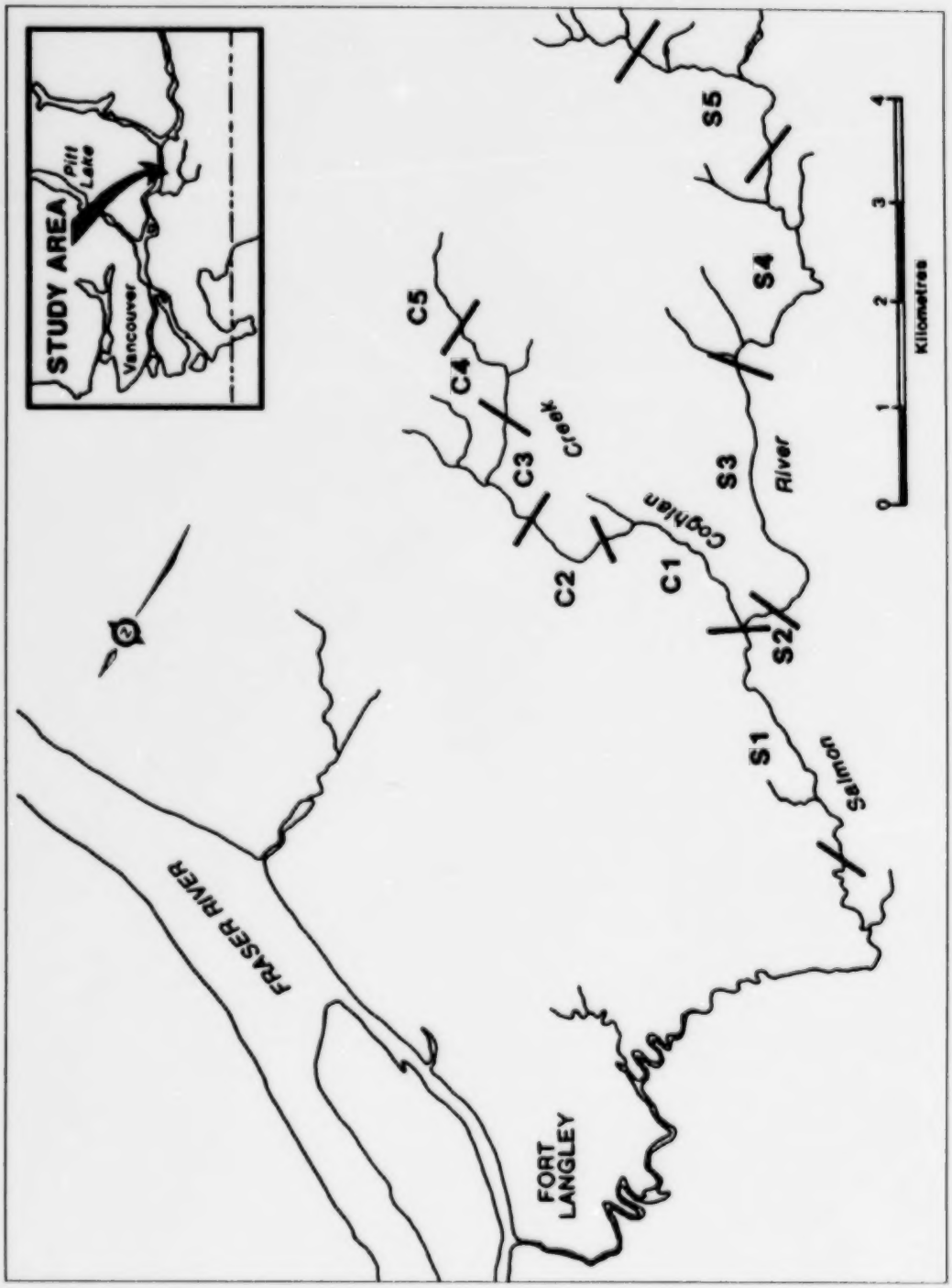

Fig 1. The Salmon River and Coghlan Creek showing reach locations.

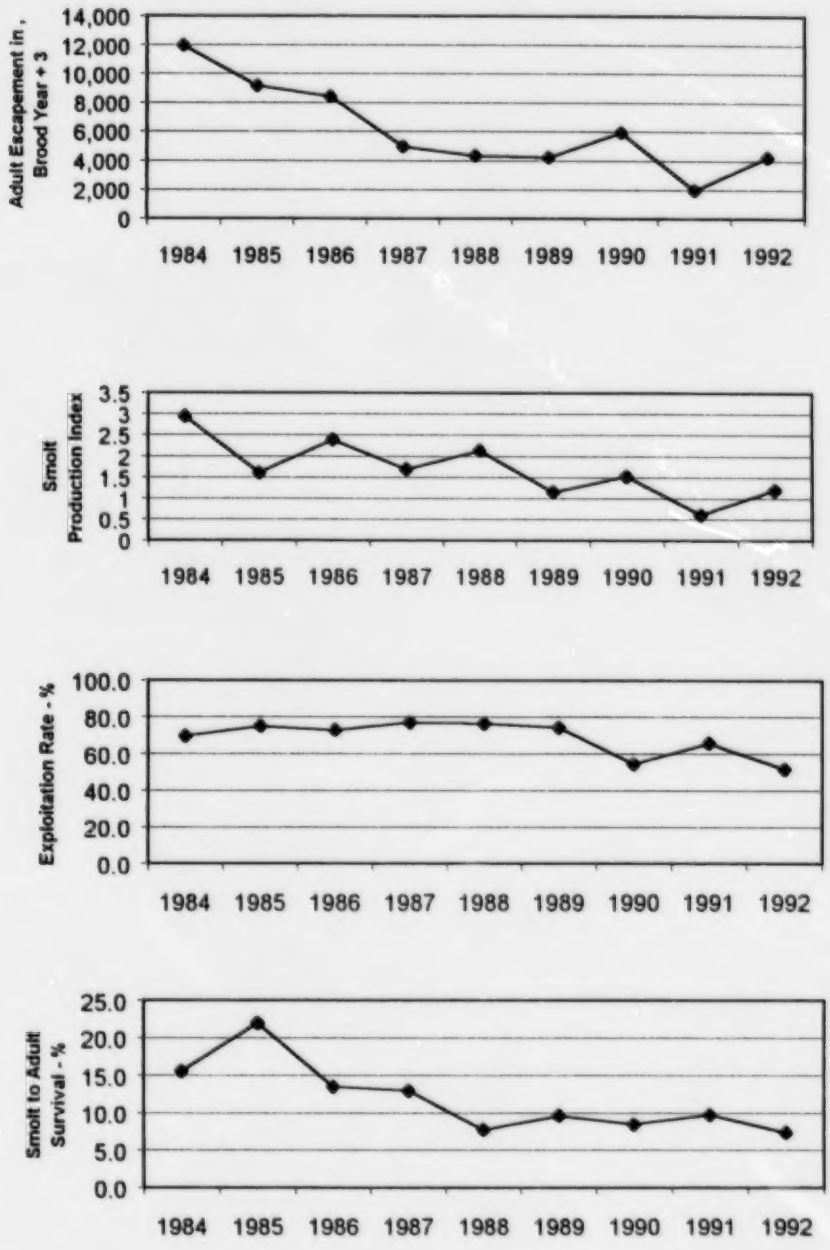

Fig. 2. Trends in adult escapement, smolt production, exploitation rate and smolt-to-adult survival, by brood year, in 1984-1992 brood Salmon River system coho salmon.

Appendix 1a. Daily enumeration of downstream migrants, by species, at the Salmon River fence trap, 1994.

Date	Water temp. (°C) a	Water level (m) b	Coho smolt	Cutthroat trout		Rainbow trout		Lamprey	Sculpin	Stickleback	Crayfish	Sucker
				Smolt	Parr	Smolt	Parr					
26-Apr	12.0	-	1,014	2	0	6	1	0	0	0	1	0
27-Apr	12.0	-	908	5	0	15	2	0	0	1	0	0
28-Apr	12.0	-	1,089	4	0	15	8	2	0	0	1	2
29-Apr	12.0	-	1,117	11	1	16	3	1	1	0	0	0
30-Apr	12.5	-	2,075	14	2	46	7	0	0	0	0	0
01-May	-	-	450	6	0	12	10	3	0	0	3	0
02-May	-	-	904	1	0	3	5	0	0	0	0	0
03-May	-	-	437	4	0	9	3	1	0	0	0	0
04-May	12.5	-	648	23	2	22	2	0	0	0	0	0
05-May	14.0	-	1,065	11	0	11	1	0	0	0	0	0
06-May	13.0	-	2,303	8	5	21	13	0	1	0	0	0
07-May	14.0	-	1,796	9	6	13	8	1	0	0	0	2
08-May	15.0	-	1,795	38	2	37	15	0	0	0	0	0
09-May	14.0	-	1,787	7	1	5	2	0	0	0	0	0
10-May	14.0	-	1,041	6	1	9	3	0	0	0	0	0
11-May	14.0	-	801	31	3	14	3	0	0	0	0	0
12-May	13.0	-	1,528	13	1	12	5	1	0	0	0	1
13-May	12.0	-	1,166	26	3	12	4	0	0	0	0	0
14-May	12.0	-	596	3	1	6	2	0	0	0	0	0
15-May	13.0	-	350	4	0	4	4	0	0	0	0	0
16-May	12.0	-	835	0	0	0	2	0	0	0	0	1
17-May	12.0	-	437	6	0	3	0	0	0	0	0	0
18-May	12.0	-	978	21	1	5	0	1	0	0	1	0
19-May	12.0	-	312	1	0	1	5	0	0	0	0	0
20-May	14.0	-	229	11	0	6	1	0	0	0	0	0
21-May	13.0	-	21	1	0	1	0	1	0	0	0	0
22-May	13.0	-	360	2	2	2	0	0	0	0	0	0
23-May	14.0	-	487	6	0	1	2	2	0	0	0	0
24-May	13.0	-	116	8	0	3	0	0	0	1	0	0
25-May	13.0	-	162	2	0	3	2	0	0	2	1	0
26-May	13.0	-	64	0	1	0	0	0	0	0	0	0
27-May	12.0	-	46	1	0	1	0	0	0	0	0	0
28-May	12.0	-	16	3	0	0	0	0	0	1	0	0
29-May	14.0	-	113	53	2	11	0	0	0	0	2	0
30-May	13.0	-	164	81	3	12	6	0	0	0	0	0
31-May	14.0	-	39	1	2	0	1	0	0	0	0	0
Total	-	-	27,249	423	39	337	120	13	2	5	9	6

a. Recorded at approximately 0900 hrs.
b. Gauge damaged.

Appendix 1b. Daily enumeration of downstream migrants, by species, at the Coghlan Creek fence trap, 1994.

Date	Water temp. (°C) a	Water level (m) b	Coho smolt	Cutthroat trout		Rainbow trout		Lamprey	Sculpin	Stickleback	Crayfish	Sucker
				Smolt	Parr	Smolt	Parr					
20-Apr	11.0	0.17	408	1	2	5	2	1	0	0	0	0
21-Apr	12.0	0.17	34	0	0	0	0	0	0	0	0	0
22-Apr	10.0	0.17	514	18	4	70	1	1	0	0	0	1
23-Apr	11.5	0.17	283	12	1	24	18	0	0	0	0	0
24-Apr	11.0	0.16	407	18	2	24	7	0	0	0	0	0
25-Apr	12.0	0.16	254	8	0	13	4	0	0	0	0	0
26-Apr	11.5	0.16	410	26	0	19	5	0	0	0	0	0
27-Apr	11.5	0.15	512	10	1	12	5	0	0	0	0	0
28-Apr	11.0	0.15	333	20	5	24	8	0	0	0	0	0
29-Apr	11.0	0.15	418	16	2	11	12	0	0	0	0	0
30-Apr	11.0	0.17	912	109	7	58	6	0	0	0	0	0
01-May	11.0	0.15	479	39	1	17	10	3	0	0	0	0
02-May	-	-	501	21	1	3	1	0	1	0	0	0
03-May	10.5	0.15	273	9	0	2	0	0	0	0	0	0
04-May	12.0	-	258	26	3	8	5	0	0	0	0	0
05-May	14.0	-	755	24	1	2	7	0	0	0	0	0
06-May	12.0	-	631	43	9	9	15	0	0	0	0	0
07-May	14.0	-	1,067	57	22	16	19	0	0	0	1	0
08-May	-	-	1,070	42	28	12	28	0	0	0	0	0
09-May	13.0	-	794	77	12	9	11	0	0	0	0	0
10-May	13.0	-	734	41	7	8	6	0	0	0	0	1
11-May	13.0	-	291	59	1	2	3	0	0	0	0	0
12-May	12.0	-	414	35	3	4	3	0	0	0	0	0
13-May	11.0	0.15	213	33	2	6	1	0	0	0	0	0
14-May	11.0	0.15	275	60	1	7	3	0	0	0	0	0
15-May	12.0	-	340	46	1	12	2	0	1	0	1	0
16-May	11.0	-	317	46	1	12	2	0	1	0	1	0
17-May	11.0	-	175	25	1	1	2	0	0	0	1	0
18-May	11.0	-	285	44	0	7	3	0	0	0	0	0
19-May	11.0	-	273	50	11	1	2	0	0	0	0	0
20-May	12.0	0.12	211	46	12	2	10	0	0	0	0	0
21-May	12.0	0.12	151	18	0	1	2	0	0	0	1	0
22-May	13.0	0.12	18	0	0	0	0	0	0	0	0	0
23-May	12.0	0.12	179	39	1	0	2	0	0	0	2	0
24-May	12.0	0.12	102	7	0	1	0	0	1	1	1	0
25-May	12.0	0.12	62	11	2	0	1	0	0	0	1	0
26-May	12.0	0.12	80	13	2	2	3	0	0	0	2	0
27-May	11.0	0.12	41	10	0	2	1	0	0	0	1	0
28-May	11.0	0.12	44	6	0	0	1	0	0	0	1	0
29-May	12.0	0.16	9	12	0	1	0	0	0	0	2	0
30-May	12.0	0.13	62	7	0	0	0	0	0	0	0	0
Total	-	-	14,589	1,184	146	407	211	5	4	1	15	2

Appendix 2a. Application of coded wire tags, by code and date, to Salmon River coho salmon smolts, 1994

CWT code	Tagging date	Maximum holding time (days)	Pre-tagging mortality	Total number marked	24 hour CWT rejection		Post tagging mortality		Total released with CWTs c
					N a	(%)	immediate	24-hour b	
18/06/62	26-Apr	0	0	1,010	253	7.5	0	0	885
	27-Apr	0	0	903	250	0.8	2	0	846
	28-Apr	0	0	1,089	275	0.4	0	0	1,028
	29-Apr	0	0	1,116	250	0.4	0	0	1,053
	02-May	1	13	2,270	305	0.7	0	0	2,133
	03-May	0	0	1,346	254	1.2	0	0	1,260
	04-May	0	0	644	293	3.4	0	7	582
	05-May	0	0	1,060	283	0.7	0	4	992
	06-May	0	0	1,285	287	1.1	0	9	1,196
18/06/63	06-May	0	0	1,004	287	1.1	0	7	934
	09-May	2	18	3,559	329	0.0	0	0	3,370
	10-May	0	1	1,085	257	0.0	0	0	1,027
	11-May	0	0	1,203	223	0.5	0	0	1,134
	12-May	0	2	1,044	261	0.0	0	0	989
	13-May	0	2	2,768	245	0.0	0	11	2,629
18/06/52	13-May	0	2	250	196	3.1	0	0	230
	16-May	2	13	1,739	290	1.4	0	12	1,613
	18-May	1	0	1,342	213	0.9	0	0	1,259
	20-May	1	0	540	245	0.8	0	4	503
	24-May	3	3	965	328	0.3	0	3	908
	27-May	2	0	250	250	0.0	0	0	237
	30-May	2	1	291	114	0.0	0	0	276
	31-May	0	0	38	38	0.0	0	0	36
18/06/62	Total (mean)	(0.1)	13	10,723	2,450	(1.8)	2	20	9,973
18/06/63	Total (mean)	(0.3)	23	10,683	1,602	(0.3)	0	18	10,084
18/06/52	Total (mean)	(1.4)	19	5,415	1,674	(0.9)	0	19	5,061
Total (mean)		(0.6)	55	26,821	5,726	(1.1)	2	57	25,118

a. Sample size held to assess tag loss.
b. Based on mortality rate observed in QCD sub-sample expanded to entire tag lot.
c. Adjusted for long term CWT loss (see text).

Appendix 2b. Application of coded wire tags, by code and date, to Coghlan Creek coho salmon smolts, 1994

CWT code	Tagging date	Maximum holding time (days)	Pre-tagging mortality	Total number marked	24 hour CWT rejection		Post tagging mortality		Total released with CWTs c
					N a	(%)	immediate	24-hour b	
18/06/61	25-Apr	0	14	1,092	310	0.7	0	4	1,023
	26-Apr	0	6	763	307	0.7	0	3	715
	26-Apr	0	0	409	272	12.5	0	0	339
	27-Apr	0	0	508	224	1.3	3	2	470
	28-Apr	0	0	320	82	1.2	0	6	292
	29-Apr	0	0	412	244	0.0	0	0	389
	02-May	2	0	363	264	0.4	0	0	342
	03-May	0	2	1,834	353	0.6	0	0	1,726
	04-May	0	0	258	255	2.4	0	0	239
	05-May	0	0	753	337	0.3	0	0	711
	06-May	0	0	630	321	0.6	0	45	550
	10-May	3	1	2,102	281	0.0	0	0	1,991
	11-May	0	2	1,534	275	6.9	0	0	1,351
Total (mean)		(0.4)	25	10,978	3,525	(2.1)	3	62	10,138

a. Sample size held to assess tag loss.
b. Based on mortality rate observed in QCD sub-sample expanded to entire tag lot.
c. Adjusted for long term CWT loss (see text).

Appendix 3. Anomalies encountered while coded wire tagging wild Salmon River system coho salmon smolts, 1994.

Location	Number inspected	Fog eye	Neascus	Scoliosis	Fin rot	General damage	Naturally missing adipose fin
Salmon River	26,869	890	769	8	356	12	14
		3.31%	2.86%	0.03%	1.32%	0.04%	0.05%
Coghlan Creek	10,986	291	19	0	353	8	9
		2.65%	0.17%	0.00%	3.21%	0.07%	0.08%
Total	37,855	1,181	788	8	709	20	23
		3.12%	2.08%	0.02%	1.87%	0.05%	0.06%

Appendix 4. Mean length and weight, by location and date, of coho salmon smolts in the Salmon River system, 1994.

Location	Sample date	Sample size	Nose-fork length (mm)		Mean wet weight (g)
			Mean	Standard deviation	
Salmon River	27-Apr	50	88.5	11.9	-
	04-May	50	93.4	11.4	8.7
	11-May	50	88.8	7.7	7.4
	18-May	50	86.5	6.1	7.0
	24-May	50	88.2	9.5	6.9
	Total	250	89.2 a	-	7.5 a
Coghlan Creek	27-Apr	50	94.0	11.8	-
	04-May	50	94.5	8.8	8.6
	11-May	50	91.7	7.8	8.0
	18-May	50	89.1	5.7	7.4
	24-May	50	88.0	7.2	7.2
	Total	250	91.6 a	-	7.9 a
Total	-	500	90.0 a	-	7.6 a

a. Weighted by proportion of smolt migration in time periods.

Appendix 5a. Daily application of disk tags and secondary marks, by reach, release condition, adipose fin status and sex, to coho adults in the Salmon River, 1995-1996.

Date	Reach a	Electroshocker volts	Released unbruised			Released with electroshocker bruising			Total			Adipose absent b	
			Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
11/1/95	S1	200	2	3	5	6	0	6	8	3	11	3	0
	S2	200	1	0	1	0	0	0	1	0	1	1	0
	S3	200	2	0	2	0	0	0	2	0	2	1	0
11/3/95	S3	200	6	6	12	5	5	10	11	11	22	6	7
	S3	300	0	1	1	1	1	2	1	2	3	0	1
	S4	200	2	1	3	0	0	0	2	1	3	1	0
11/6/95	S1	200	10	4	14	0	0	0	10	4	14	4	3
	S2	200	0	1	1	0	0	0	0	1	1	0	1
	S4	200	6	2	8	0	1	1	6	3	9	5	0
	S5	200	0	0	0	1	0	1	1	0	1	0	0
11/10/95	S1	200	10	4	14	4	4	8	14	8	22	4	3
	S1	300	1	0	1	0	1	1	1	1	2	0	1
	S2	200	1	2	3	0	1	1	1	3	4	1	0
	S2	300	1	0	1	0	0	0	1	0	1	1	0
11/15/95	S3	300	1	0	1	1	0	1	2	0	2	0	0
11/17/95	S1	300	2	2	4	0	2	2	2	4	6	1	0
	S2	300	1	0	1	1	0	1	2	0	2	1	0
	S5	300	1	2	3	1	1	2	2	3	5	1	1
11/22/95	S1	300	4	1	5	1	3	4	5	4	9	1	1
11/24/95	S5	300	2	1	3	1	0	1	3	1	4	2	0
12/1/95	S1	300	0	1	1	0	0	0	0	1	1	0	0
	S2	300	1	0	1	0	0	0	1	0	1	0	0
	S3	300	2	1	3	0	0	0	2	1	3	1	0
	S5	300	1	0	1	0	0	0	1	0	1	1	0
12/8/95	S1	300	2	2	4	0	0	0	2	2	4	0	0
	S2	300	2	1	3	0	0	0	2	1	3	0	0
12/19/95	S1	300	1	0	1	0	0	0	1	0	1	0	0
	S3	300	0	3	3	0	0	0	0	3	3	0	0
12/20/95	S2	300	0	0	0	1	0	1	1	0	1	0	0
12/28/95	S1	300	1	1	2	0	0	0	1	1	2	1	1
Total	S1	-	33	18	51	11	10	21	44	28	72	14	9
	S2	-	7	4	11	2	1	3	9	5	14	4	1
	S3	-	11	11	22	7	6	13	18	17	35	8	8
	S4	-	8	3	11	0	1	1	8	4	12	6	0
	S5	-	4	3	7	3	1	4	7	4	11	4	1
Total	-	-	63	39	102	23	19	42	86	58	144	36	19

a. Salmon River reaches: S1 - below Coghlan Creek. S4 - 56 Ave. to 248 St.
S2 - Coghlan Creek to 64 Ave. S5 - 248 St. to 256 St.
S3 - 64 Ave. to 56 Ave.

b. Included in 'Total' column.

Appendix 5b. Daily application of disk tags and secondary marks, by reach, release condition, adipose fin status and sex, to coho adults in Coghlan Creek, 1995-1996.

Date	Reach a	Electroshocker Volts	Released unbruised			Released with electroshocker bruising			Total			Adipose absent b	
			Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
11/1/95	C1	200	0	1	1	0	2	2	0	3	3	0	0
11/3/95	C1	200	2	0	2	4	1	5	6	1	7	1	0
	C2	300	0	0	0	0	1	1	0	1	1	0	0
11/10/95	C2	200	3	2	5	1	5	6	4	7	11	2	4
11/15/95	C1	300	3	0	3	3	2	5	6	2	8	1	1
	C1	400	1	0	1	1	0	1	2	0	2	0	0
	C4	400	1	0	1	0	0	0	1	0	1	0	0
	C5	300	0	0	0	4	2	6	4	2	6	2	2
11/20/95	C1	200	0	0	0	2	1	3	2	1	3	0	0
	C1	300	4	2	6	11	7	18	15	9	24	1	1
	C2	300	3	0	3	3	3	6	6	3	9	1	1
11/24/95	C3	300	0	0	0	1	0	1	1	0	1	1	0
	C4	300	0	0	0	0	1	1	0	1	1	0	1
	C5	300	0	1	1	1	3	4	1	4	5	1	3
12/4/95	C1	300	0	1	1	2	2	4	2	3	5	0	0
12/8/95	C1	300	0	1	1	4	3	7	4	4	8	0	0
12/13/95	C3	300	0	0	0	2	2	4	2	2	4	0	0
12/18/95	C1	300	1	0	1	1	1	2	2	1	3	0	0
12/19/95	C1	300	0	0	0	0	2	2	0	2	2	0	0
12/22/95	C2	300	1	0	1	1	0	1	2	0	2	0	0
Total	C1	-	11	5	16	28	21	49	39	26	65	3	2
	C2	-	7	2	9	5	9	14	12	11	23	3	5
	C3	-	0	0	0	3	2	5	3	2	5	1	0
	C4	-	1	0	1	0	1	1	1	1	2	0	1
	C5	-	0	1	1	5	5	10	5	6	11	3	5
	Total	-	19	8	27	41	38	79	60	46	106	10	13

a. Coghlan Creek reaches: C1 - Salmon River to Hwy. 1. C4 - 64 Ave. to 256 St.
C2 - Hwy. 1 to 248 St.
C3 - 248 St. to 64 Ave.
C5 - Above 256 St.

b. Included in 'Total' column.

Appendix 6. Disk tag and secondary mark recoveries, by application and recovery date and location, size, sex, adipose fin status and disk tag number, of coho salmon adults released in the Salmon River system, 1995-1996.

Application sample							Recovery sample					
Date	Reach a	Electro-shocker volts	NF length (cm)	sex	Adipose fin	Disk tag number	Date	Reach a	POH length (cm)	Sex	Age	Days out
10-Nov	C2	200	59.0	M	A	2552 c	27-Nov	C2	44.4	M	3/2	17
10-Nov	C2	200	66.0	F	P	2556 c	22-Nov	C2	51.0	F	3/2	12
15-Nov	C5	300	51.0	F	A	2565	27-Dec	C4	-	-	n/a	42
15-Nov	C1	300	51.0	F	A	2571	27-Nov	C1	40.8	F	n/a	12
15-Nov	C1	300	51.0	M	P	2573	19-Jan	C3	-	-	-	65
1-Nov	S1	200	56.5	F	P	21501	16-Jan	C1	-	-	-	76
1-Nov	C1	200	60.5	F	P	21514	20-Nov	S1	-	F	-	19
3-Nov	S3	200	56.5	M	A	21533	8-Jan	S5	41.5	M	n/a	66
3-Nov	S3	200	63.5	M	A	21538	20-Dec	S3	46.8	M	3/2	47
3-Nov	S3	200	57.0	F	P	21539	4-Dec	S2	46.8	F	n/a	31
6-Nov	S1	200	50.0	M	A	21558 b	6-Dec	C1	39.5	M	4/3	30
6-Nov	S1	200	51.5	F	A	21560	4-Dec	S1	-	F	3/2	28
10-Nov	S1	300	52.0	M	P	21583	12-Jan	S1	-	M	3/2	63
10-Nov	S1	200	51.0	M	P	21585 c	27-Dec	S1	39.2	M	3/2	47
20-Nov	C1	300	59.5	M	A	21614	4-Dec	S1	46.7	M	3/2	14
20-Nov	C1	300	54.0	M	P	21616	6-Dec	C1	41.9	M	n/a	16
20-Nov	C1	300	57.0	F	P	21625	21-Dec	C2	45.2	F	3/2	31
20-Nov	C1	300	54.0	F	P	21627	15-Dec	C1	40.7	F	3/2	25
20-Nov	C1	300	50.5	F	P	21632	21-Dec	C1	-	-	-	31
20-Nov	C2	300	57.5	F	P	21642	15-Dec	C1	45.3	F	n/a	25
22-Nov	S1	300	53.0	F	P	21648 c	4-Dec	S1	44.6	F	3/2	12
22-Nov	S1	300	52.0	M	P	21652	4-Dec	S4	42.3	M	3/2	12
22-Nov	S1	300	57.5	M	A	21653 c	27-Dec	S1	-	-	-	35
24-Nov	C5	300	54.5	F	P	21654	6-Dec	C4	46.4	F	3/2	12
24-Nov	C5	300	50.5	M	A	21655	27-Nov	C4	40.9	M	n/a	3
24-Nov	C5	300	54.0	F	A	21656	27-Nov	C4	45.5	F	3/2	3
24-Nov	C5	300	50.0	F	A	21658	27-Nov	C5	41.7	F	n/a	3
24-Nov	C4	300	52.5	F	A	21659 b	27-Nov	C4	42.4	F	3/2	3
1-Dec	S3	300	63.5	M	P	21669	4-Dec	S3	-	M	3/2	3
8-Dec	C1	300	57.0	F	P	21685	15-Dec	C1	46.0	F	3/2	7
13-Dec	C3	300	59.0	F	P	21694	15-Dec	C2	48.8	F	3/2	2
18-Dec	C1	300	48.0	M	P	21696	21-Dec	C1	39.6	M	3/2	3

			Mean days out:	24.8
Females initially identified as males:	0	0.0%	Max. days out:	76.0
Males initially identified as females:	0	0.0%	Min. days out:	2.0

POH length and NF length regressions:

Males: POH length = 0.52 NF length + 14.26
NF length = 1.64 POH length - 14.85

Females: POH length = 0.64 NF length + 9.25
NF length = 1.19 POH length + 2.21

a. See Appendix 5 for reach descriptions.

b. Required ventilation at release.

c. Bruised at release.

n/a. Scales not ageable

Appendix 7a. Daily coho carcass recoveries, by reach, mark status and sex, in the Salmon River, 1995-1996.

		Unmarked			Disk tag and secondary mark		Disk tag only		Total			Adipose absent a		
Date	Reach	Male	Female	Jack	Male	Female	Male	Female	Male	Female	Unknown sex	Male	Female	Jack
20-Nov	S1	4	3	3	0	1	0	0	4	4	0	0	3	0
	S2	1	0	0	0	0	0	0	1	0	0	1	0	0
	S3	6	4	1	0	0	0	0	6	4	0	4	2	0
27-Nov	S5	2	3	0	0	0	0	0	2	3	0	1	2	0
4-Dec	S1	6	9	0	1	0	0	2	7	11	0	2	2	0
	S2	0	1	0	0	1	0	0	0	2	0	0	0	0
	S3	10	4 c	0	1	0	0	0	11	4	2	3	4	0
	S4	11	13 b	1	1	0	0	0	12	13	1	6	6	0
6-Dec	S5	4	2	0	0	0	0	0	4	2	0	2	0	0
20-Dec	S1	13	10 c	0	0	0	0	0	13	10	2	1	0	0
	S2	0	1 b	0	0	0	0	0	0	1	1	0	0	0
	S3	6	5 b	1	1	0	0	0	7	5	1	2	3	1
	S4	12	7 b	0	0	0	0	0	12	7	1	5	3	0
21-Dec	S2	1	0	0	0	0	0	0	1	0	0	0	0	0
	S5	1	2	0	0	0	0	0	1	2	0	0	1	0
27-Dec	S1	7	2 b	0	1	0	0	0 b	8	2	2	3	0 b	0
	S3	2	4	0	0	0	0	0	2	4	0	1	1	0
	S4	4	4	0	0	0	0	0	4	4	0	1	1	0
	S5	1	0	0	0	0	0	0	1	0	0	0	0	0
3-Jan	S3	2	0	0	0	0	0	0	2	0	0	0	0	0
	S5	0	1	0	0	0	0	0	0	1	0	0	0	0
4-Jan	S1	2	4 b	0	0	0	0	0	2	4	1	0	0	0
	S4	3	2	0	0	0	0	0	3	2	0	1	1	0
8-Jan	S1	1	3	0	0	0	0	0	1	3	0	0	0	0
	S3	1	3 b	0	0	0	0	0	1	3	1	0	1	0
	S4	3	1	0	0	0	0	0	3	1	0	2	1	0
	S5	0	0	0	0	0	1	0	1	0	0	1	0	0
12-Jan	S1	1	0 d	0	0	0	1	0	2	0	3	1	0	0
	S3	0	0 b	0	0	0	0	0	0	0	1	0	0	0
17-Jan	S1	1	2	1	0	0	0	0	1	2	0	0	0	0
	S3	0	0 b	0	0	0	0	0	0	0	1	0	0	0
	S4	1	2	0	0	0	0	0	1	2	0	0	1	0
22-Jan	S1	1	0	0	0	0	0	0	1	0	0	1	0	0
26-Jan	S1	1	0	0	0	0	0	0	1	0	0	0	0	0
Total	S1	37	33	4	2	1	1	2	40	36	8	8	5	0
	S2	2	2	0	0	1	0	0	2	3	1	1	0	0
	S3	27	20	2	2	0	0	0	29	20	6	10	11	1
	S4	34	29	1	1	0	0	0	35	29	2	15	13	0
	S5	8	8	0	0	0	1	0	9	8	0	4	3	0
	Total	108	92	7	5	2	2	2	115	96	17	38	32	1

a. Included in 'Total' column.
b. Excludes 1 coho of unknown sex.
c. Excludes 2 coho of unknown sex.
d. Excludes 3 coho of unknown sex.

Appendix 7b. Daily coho carcass recoveries, by reach, mark status and sex, in Coghlan Creek, 1995-1996.

		Unmarked			Disk tag and secondary mark		Disk tag only		Total			Adipose absent a		
Date	Reach	Male	Female	Jack	Male	Female	Male	Female	Male	Female	Unknown sex	Male	Female	Jack
17-Nov	C1	2	2	3	0	0	0	0	2	2	0	1	1	0
22-Nov	C2	7	8	2	0	1	0	0	7	9	0	3	3	0
	C3	7	8	0	0	0	0	0	7	8	0	3	8	0
	C4	2	0	0	0	0	0	0	2	0	0	1	0	0
27-Nov	C1	8	8	3	0	1	0	0	8	9	0	2	2	0
	C2	4	5 b	1	1	0	0	0	5	5	1	4	0	1
	C3	8	7	1	0	0	0	0	8	7	0	3	4	1
	C4	3	2	0	1	2	0	0	4	4	0	2	3	0
	C5	2	1	0	0	1	0	0	2	2	0	1	2	0
6-Dec	C1	7	6 d	0	2	0	0	0	9	6	4	3	0b	0
	C2	9	5 c	1	0	0	0	0	9	5	2	2	4b	0
	C3	3	4	0	0	0	0	0	3	4	0	0	2	0
	C4	3	1	1	0	1	0	0	3	2	0	1	0	1
	C5	1	1	0	0	0	0	0	1	1	0	0	1	0
15-Dec	C1	10	3 c	0	0	3	0	0	10	6	2	2	0	0
	C2	5	5 b	5	0	1	0	0	5	6	1	1	0	3
	C3	1	1	0	0	0	0	0	1	1	0	1	0	0
	C4	4	1	0	0	0	0	0	4	1	0	3	1	0
	C5	0	0	1	0	0	0	0	0	0	0	0	0	0
21-Dec	C1	4	5 c	1	1	0	0	0b	5	5	3	0	1	0
	C2	4	10	1	0	1	0	0	4	11	0	1	4	0
	C3	4	1	0	0	0	0	0	4	1	0	0	0	0
	C4	0	1	0	0	0	0	0	0	1	0	0	1	0
	C5	1	0	0	0	0	0	0	1	0	0	1	0	0
27-Dec	C4	1	1	0	0	0	0	0b	1	1	1	0	1b	0
28-Dec	C1	5	1	1	0	0	0	0	5	1	0	0	0	1
	C2	4	1	0	0	0	0	0	4	1	0	2	0	0
	C3	1	3 b	0	0	0	0	0	1	3	1	0	1b	0
2-Jan	C1	0	2	0	0	0	0	0	0	2	0	0	2	0
	C2	1	1	0	0	0	0	0	1	1	0	0	0	0
	C3	1	0	1	0	0	0	0	1	0	0	1	0	1
	C4	1	0	0	0	0	0	0	1	0	0	0	0	0
5-Jan	C1	4	2	0	0	0	0	0	4	2	0	0	0	0
	C2	1	2 b	0	0	0	0	0	1	2	1	0	0	0
	C3	1	2	0	0	0	0	0	1	2	0	0	1	0
10-Jan	C1	1	3 d	1	0	0	0	0	1	3	4	0	0	0
	C2	1	2	0	0	0	0	0	1	2	0	1	0	0
	C4	0	1	0	0	0	0	0	0	1	0	0	0	0
16-Jan	C1	1	2	0	0	0	0	0b	1	2	1	0	1	0
	C2	0	1	0	0	0	0	0	0	1	0	0	0	0
	C4	0	1	1	0	0	0	0	0	1	0	0	1	0
19-Jan	C1	0	1	0	0	0	0	0	0	1	0	0	0	0
	C2	2	0	0	0	0	0	0	2	0	0	0	0	0
	C3	0	0	0	0	0	0	0b	0	0	1	0	0	0
	C4	0	1	0	0	0	0	0	0	1	0	0	1	0
Total	C1	42	35	9	3	4	0	0	45	39	14	8	7	1
	C2	38	40	10	1	3	0	0	39	43	5	14	11	4
	C3	26	26	2	0	0	0	0	26	26	2	8	14	2
	C4	14	9	2	1	3	0	0	15	12	1	7	8	1
	C5	4	2	1	0	1	0	0	4	3	0	2	3	0
	Total	124	112	24	5	11	0	0	129	123	22	39	43	8

a. Included in 'Total' column.
b. Excludes 1 coho of unknown sex.
c. Excludes 2 coho of unknown sex.
d. Excludes 4 coho of unknown sex.

Appendix 8. Proportion at age and mean length at age, by location, AFC status and sex, of coho carcasses recovered on the Salmon River system spawning grounds, 1995-1996.

			Female			Male		
	Mark status	Age a	Sample size	Percent	Mean POH length (cm)	Sample size	Percent	Mean POH length (cm)
Salmon River	Unmarked	4/3	0	0.0%	-	0	0.0%	-
		3/2	13	100.0%	46.7	15	100.0%	45.7
		2/2	0	0.0%	-	0	0.0%	-
		Total	21	48.8%	45.2	22	51.2%	44.4
	Adipose fin clip	4/3	0	0.0%	-	0	0.0%	-
		3/2	20	100.0%	44.8	16	100.0%	44.5
		2/2	0	0.0%	-	0	0.0%	-
		Total	28	47.5%	44.3	31	52.5%	43.5
	Total	4/3	0	0.0%	-	0	0.0%	-
		3/2	33	100.0%	45.5	31	100.0%	45.1
		2/2	0	0.0%	-	0	0.0%	-
		Total	49	48.0%	44.7	53	52.0%	43.9
Coghlan Creek	Unmarked	4/3	0	0.0%	-	0	0.0%	-
		3/2	22	100.0%	44.3	21	95.5%	42.8
		2/2	0	0.0%	-	1	4.5%	33.4
		Total	27	44.3%	44.4	34	55.7%	42.2
	Adipose fin clip	4/3	0	0.0%	-	2	11.8%	38.3
		3/2	20	100.0%	43.9	15	88.2%	42.0
		2/2	0	0.0%	-	0	0.0%	-
		Total	41	51.9%	43.7	38	48.1%	40.9
	Total	4/3	0	0.0%	-	2	5.1%	38.3
		3/2	42	100.0%	44.1	36	92.3%	42.5
		2/2	0	0.0%	-	1	2.6%	33.4
		Total	68	48.6%	44.0	72	51.4%	41.5
Total	Unmarked	4/3	0	0.0%	-	0	0.0%	-
		3/2	35	100.0%	45.1	36	97.3%	43.9
		2/2	0	0.0%	-	1	2.7%	33.4
		Total	48	46.2%	44.7	56	53.8%	43.0
	Adipose fin clip	4/3	0	0.0%	-	2	6.1%	38.3
		3/2	40	100.0%	44.3	31	93.9%	43.2
		2/2	0	0.0%	-	0	0.0%	-
		Total	69	50.0%	44.0	69	50.0%	42.0
	Total	4/3	0	0.0%	-	2	2.9%	38.3
		3/2	75	100.0%	44.7	67	95.7%	43.6
		2/2	0	0.0%	-	1	1.4%	33.4
		Total	117	48.3%	44.3	125	51.7%	42.4

a. Totals include unageable samples

Appendix 9. AFC and CWT sampling of coho salmon recovered on the Salmon River system spawning grounds, 1995-1996.

			Recovered in Salmon River				Recovered in Coghlan Creek				Total	
			Adult male	Adult female	Adult total	Jack	Adult male	Adult female	Adult total	Jack	Adult total	Jack
Sample size			115	96	228 d	7	129	123	274 e	24	502	31
Number with AFCs			38	32	71 a	1	39	43	86 b	8	157	9
- AFC but no head			4	1	6 a	0	1	3	7 c	1	13	1
- CWT lost during processing			0	0	0	0	0	0	0	0	0	0
- AFC but no CWT present			8	8	16	1	2	11	14 a	3	30	4
- CWT recovered:												
Code	*Brood*	*Release site*										
18 06 52	1992	Salmon River	2	3	5	0	1	0	1	0	6	0
18 06 61	1992	Coghlan Creek	3	2	5	0	25	21	46	0	51	0
18 06 62	1992	Salmon River	10	12	22	0	4	2	6	0	28	0
18 06 63	1992	Salmon River	11	6	17	0	5	6	11	0	28	0
18 18 54	1993	Salmon River	0	0	0	0	0	0	0	1	0	1
18 18 55	1993	Coghlan Creek	0	0	0	0	1	0	1	3	1	3
Total			26	23	49	0	36	29	65	4	114	4
AFC incidence (%)			33.0%	33.3%	31.1%	14.3%	30.2%	35.0%	31.4%	33.3%	31.3%	29.0%
CWT loss (%)			23.5%	25.8%	24.6%	100.0%	5.3%	27.5%	17.7%	42.9%	20.8%	50.0%
Adjusted CWT loss (%) f			12.5%	7.1%	9.5%	0.0%	0.0%	5.0%	2.8%	0.0%	5.3%	0.0%

a. Includes 1 of unknown sex.
b. Includes 4 of unknown sex
c. Includes 3 of unknown sex.
d. Includes 17 of unknown sex.
e. Includes 22 of unknown sex.
f. See Results, Coded Wire Tag Recoveries section.

Appendix 10. Incidence of CWT loss, by carcass condition, eye status, and AFC condition, in adult AFC coho carcasses recovered on the Salmon River system spawning grounds, 1995-1996.

Observation	Condition	Number of AFC carcasses	Status unknown a	CWT absent	CWT loss
Carcass condition	Fresh	21	2	1	5.3%
	Moderately fresh	32	1	2	6.5%
	Moderately rotten	36	1	4	11.4%
	Rotten	68	0	23	33.8%
	Not recorded	0	0	0	-
Eyes	Both present	21	0	5	23.8%
	One or both absent	134	4	25	19.2%
	Not recorded	2	0	0	0.0%
Adipose fin clip	Complete	98	3	7	7.4%
	Partial	23	1	8	36.4%
	Questionable	36	0	15	41.7%
	Not recorded	0	0	0	-

a. Either a carcass with no head or the head was lost during processing.

Appendix 11. Spawning success in female coho carcasses recovered on the Salmon River system spawning grounds, 1995-1996.

Mark status		Percent spawned 0%	50%	100%	Weighted mean
Disk tag or secondary mark	Number	1	0	14	
	Percent	6.7%	0.0%	93.3%	93.3%
Unmarked	Number	0	2	135	
	Percent	0.0%	1.5%	98.5%	99.3%
Total	Number	1	2	149	
	Percent	0.7%	1.3%	98.0%	98.7%

Appendix 12. Estimated coded wire tag (CWT) catch recovery of 1992 brood year coho in 1995 (only), from CWT'd smolts released in Salmon River (Langley) system. [a]

Fishery	Location	Estimated catch in 1995					
		Jun	Jul	Aug	Sep	Oct	Total
Sport	Georgia Str.,South					55	55
	Juan de Fuca	11	10	2	22	5	50
	West Coast Vancouver Island	19					19
	Washington			67	55		122
	Oregon (Freshwater)					5	5
Troll	Northwest Vancouver Island		77	55	10		142
	South/central B.C				5		5
	Southwest Vancouver Island	4	498	137	107		746
	Washington			92			92
Net	Juan de Fuca			25	28		53
	Johnstone Str.			3			3
	Washington		11	17	13		41
All	All	34	596	397	240	65	1332

[a] The estimated total catch recoveries (in parentheses) were from CWT release codes 18-06-52 (178), 18-06-61 (425), 18-06-62 (340) and 18-06-63 (392).